

spillway and take-off tunnel, for the rock-filled portion, and a surface covering at the north end of the dam, 10 to 15 feet in depth, was used for the hydraulic fill.

The drainage area above the dam is 666 square miles and from the meager data at hand it has been estimated that the average annual run-off will be 163,000 acre-feet. In addition to the drainage from the Blackfoot Basin, the flood water rights from John Grays Lake (which lies but a few miles northeasterly from the Blackfoot reservoir), having an estimated flood discharge of 50,000 acre-feet, have been secured.

The reservoir lies at an elevation of 6,200 feet above sea level, surrounded on all sides by rather high hills and mountains, having generally long easy slopes.

The Blackfoot River, following a tortuous course between the mountains, comes from a southeasterly direction from near the State line to where it enters the reservoir, and it is from this source that most of the water will be derived.

On the lower slopes of the mountains and hills there is a scant growth of timber, but toward the top of the peaks considerable quaking aspen and pine may be found.

The winters are long and cold and the snowfall is heavy. Along the valleys and on the open stretches the snow often attains a depth of 4 feet on the level, while on the mountains and in the gulches, especially in the vicinity of the Caribou Mountains, the snow attains to great depths.

PAYETTE-BOISE PROJECT, IDAHO.

By F. W. HANNA, Project Engineer, U. S. Reclamation Service.

HISTORY.

Preliminary investigations were begun by the Reclamation Service on the Payette-Boise Project in 1903, and in the month of December of that year steps were taken by some of the leading citizens of the Payette and Boise valleys toward a preliminary organization of the landowners. On March 4, 1904, a committee of this organization addressed a communication to the Secretary of the Interior setting forth the general irrigation conditions in the valleys, agreeing to form a permanent organization of the landholders upon the approval of the project. This communication was printed as Senate Document 247 and was referred to the Director of the United States Geological Survey, who recommended to the Secretary of the Interior that surveys and examinations of the project be continued. Following this recommendation a permanent organization of the landholders of the valley was formed on August 10, 1904, under the title of the Payette-Boise Water Users' Association. In pursuance of the recommendations of the Director of the Geological Survey to the Secretary of the Interior, general investigations of the project were continued and were brought to a conclusion during the field season of 1904.

On March 27, 1905, favorable recommendations having been made as to the feasibility of the project, the Secretary of the Interior approved the project and set aside \$1,300,000 for use in starting work. Immediately following the approval of the project negotiations were instituted for the transfer to the Reclamation Service of the New York Canal and for the purchase of the lands lying within the site of the Deer Flat reservoir, and general surveys relating to the south side unit of the project were pushed to completion by the close of 1905. On February 1, 1906, bids were opened for the construction of the Boise River diversion dam, the main south side canal to partial capacity leading from this dam to the Deer Flat reservoir and for the upper Deer Flat and lower Deer Flat embankments.

In March, 1908, excavation of the canals and laterals of the distribution system was begun under the cooperative plan with the Payette-Boise Water Users' Association, and the construction of the structures thereon was undertaken by force account, on which basis the work proceeded until September 10, 1909. Subsequent to this date, construction of the structures on the

distribution system has been carried on by force account as before and the excavation of the laterals has been done by the settlers by means of small contracts.

In the original undertaking of the project, lands lying north of the Boise River in the Boise and Payette valleys were comprehended in the limits of the project, but no work has been done on this portion of the project, except of a very preliminary investigative character. Recently, there has been formed what is known as the Black Rock Canyon Irrigation District, comprising the settlers of this portion of the project for the purpose of taking up the construction of an irrigation system for all the lands originally included in the north side portion of the Payette-Boise Project.

LOCATION AND CLIMATIC CONDITIONS.

The Payette-Boise Project is located in the southwestern part of Idaho, in the valleys of the Snake and Boise rivers, in Ada and Canyon counties. The average elevation of this irrigable area above sea level is 2,500 feet, the average rainfall is about 13 inches, and the range of extreme temperatures is from 100° to -28° F. The project is served by the Oregon Short Line, the Boise, Nampa and Owyhee, and the Idaho Northern railroads, and by the Boise Valley and the Boise and Interurban electric lines, the principal towns on the project being Boise, Nampa, and Caldwell.

IRRIGABLE LANDS.

The present Payette-Boise Project contains 243,000 acres of irrigable land, 164,000 of which are new lands and 79,000 of which are old lands, consisting of 18,000 acres under the old New York Canal, 25,000 under the Ridenbaugh Canal in the Nampa-Meridian Irrigation District, and 36,000 acres in the Pioneer Irrigation District. Of these lands 85,820 acres are entered subject to the reclamation act, 30,059 acres are State lands, and 127,130 acres are private lands. The soil consists, generally, of loam and sandy loam and is highly productive in character, being adapted to the economical production of alfalfa, clover, timothy, small grains, sugar beets, hardy varieties of apples, prunes, and small fruits.

IRRIGATION DISTRICTS AND NEW YORK CANAL COMPANY.

Reference has already been made to the "old lands" of the project and a word of explanation as to what is meant by this expression will be in place. Within the limits of the Payette-Boise Project and forming a part thereof are two irrigation districts and the New York Canal Company lands. These organizations consist of the Pioneer Irrigation District, controlling the Phyllis and Caldwell canals in position to cover 36,000 acres now irrigated; the Nampa-Meridian Irrigation District, controlling the Ridenbaugh Canal in position to cover 25,000 acres now irrigated and 30,000 acres of new land ultimately to be covered by it through feeding from the main south side canal; and the New York Canal Company lands, comprising 18,000 acres under irrigation lying under the main south side canal. All of these lands have adequate flood water rights, but are mainly signed up with the Payette-Boise Water Users' Association to receive stored water from the Payette-Boise Project.

WATER SUPPLY.

The water supply for the Payette-Boise Project is derived from the Boise River, comprising a watershed of approximately 2,610 square miles, with an average elevation above sea level of approximately 5,000 feet, on which the annual rainfall is about 25 inches. The maximum run-off of the Boise River is about 3,000,000 acre-feet, the mean about 2,000,000 acre-feet, and the minimum about 1,000,000 acre-feet per annum. The flood season in the Boise River generally covers the months of March, April, May, June, and a portion of July. During the latter part of July and the remainder of the irrigation season, the normal flow of the river has to be supplemented with stored water for the lands of the project. The duty of water for the project has

been tentatively placed at $2\frac{1}{2}$ acre-feet per acre per annum, measured on the land. There are prior appropriations of water from the river for about 130,000 acres of land under cultivation and the Payette-Boise project has appropriations succeeding these rights.

DESCRIPTION OF IRRIGATION PLANS.

The project contemplates the construction of storage reservoirs on the headwaters of the Boise River, the Deer Flat reservoir near Nampa and Caldwell, a diversion dam on the Boise River at a point about 8 miles above Boise, diverting water on the south side of the river into an inlet, and distributing canal supplying the Deer Flat reservoir and covering lands on the south side of the Boise River in the Boise and Snake river valleys. This dam also diverts water into a small canal at its right extremity, supplying a small area of land lying north of the Boise River above Boise. The storage reservoirs on the Boise River are under investigation, Deer Flat reservoir is practically completed, the Boise River diversion dam is completed, and the distributing system, including the main canals, is well under way.

BOISE RIVER STORAGE.

It is estimated that from 150,000 to 200,000 acre-feet of water will have to be stored on the headwaters of the Boise River, depending upon the ultimate decreed duty of water in the Boise Valley. The Boise River Basin is not well adapted to storage development, having narrow channels, very steep gradients, and, as a rule, ineconomical dam sites. There have been selected for investigation seven reservoir sites on the Boise River and its tributaries that are designated and located as follows: Hellgate on Boise River, Twin Springs and Rossi on North Fork of Boise River, Alexander on Middle Fork of Boise River, Joy, Casey, and Bascum on South Fork of Boise River, and Grimes on Grimes Creek, and borings are now in progress on some of the dam sites.

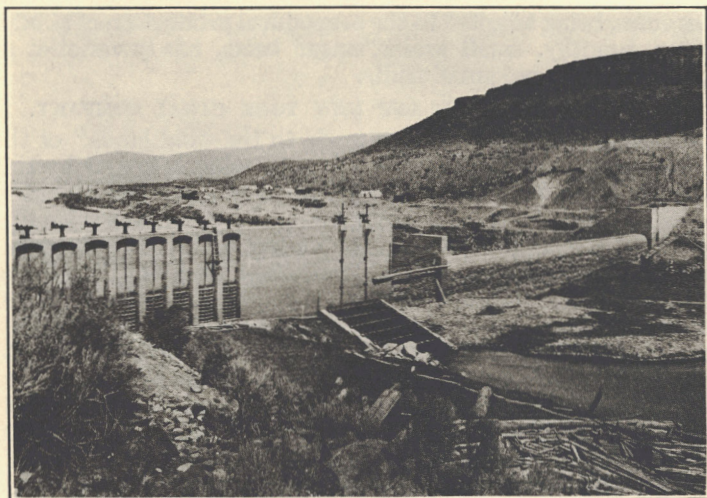


FIG. 1.—Upstream face of Boise River Dam. Payette-Boise Project.

BOISE RIVER DIVERSION DAM.

The Boise River diversion dam, located about 8 miles above Boise on the Boise River, is of the cyclopean masonry weir type, has a maximum height of 45 feet, and a length of crest, including the logway, of 246 feet. This structure serves the purpose of diversion, raising water in the Boise River to the elevation of the intakes of the penitentiary and main south side canals. It was constructed under contract by the Utah Fireproofing Company, work having been started in March, 1906, and completed in October, 1908. In the spring of 1909 the apron of the dam was badly damaged by a drive of logs passing over the spillway on account of the giving way of the log boom. The work of repair-

ing the apron, together with the placing of additional riprap below the dam, was done in the fall of 1909.



FIG. 2.—Spillway Boise River Dam at flood stage. Payette-Boise Project.

MAIN SOUTH SIDE CANAL.

The Main South Side Canal begins at the Boise River dam and extends in a southwesterly direction for a distance of about 40.6 miles, the first 23.6 miles of the canal runs over bench lands south of Boise to its intersection with Indian Creek. At this point the waters of the canal are discharged into Indian Creek and flow for a distance of about 9 miles, where they are diverted from this stream by means of a dam and head gates into a second stretch of the main canal 8 miles in length, terminating in Deer Flat reservoir. The function of the canal is to supply lands lying directly under it and to feed the Ridenbaugh Canal and the Deer Flat reservoir. This canal is ultimately to have a capacity of 2,500 second-feet, in addition to the old New York Canal rights, requiring a bottom width in earth sections of 70 feet and a height of bank above canal grade of 12 feet. Under the original contracts, on account of insufficient funds for its immediate completion, the canal was constructed with a bottom width of 40 feet throughout its entire length, with here and there short stretches excavated to a bottom width of 70 feet. The earthwork of the first division was constructed under contract by Wm. H. Thompson in 1906, 1907, and 1908. The earthwork of the second section and practically all of the structures on the canal were constructed under contract by Page & Brinton in 1906, 1907, and 1908. The earthwork of the third section was constructed under contract by Conway & Wilhite in 1906, 1907, and 1908. On November 1, 1909, there were lined with concrete approximately 24,600 linear feet of the canal, and it is proposed to line an additional 7,000 feet for the purpose of preventing excessive seepage and liabilities of breaks and to obtain capacity. Eleven checks for the purpose of controlling the canal velocity and assisting in getting the water out of the canal during low water were also installed in the fall of 1909. Bids were opened on July 8, 1910, and a contract was awarded to W. J. Hoy Company for enlarging to a 70-foot bottom width all of the portions requiring enlarging from the dam to Indian Creek, except a small stretch that it is proposed to enlarge during the coming fall by force account. This work is to be completed by April 1, 1912. The stretch of canal from Indian Creek diverting works to the Deer Flat reservoir has sufficient capacity without further enlargement.

DISTRIBUTION SYSTEM FROM MAIN SOUTH SIDE CANAL.

The new lands served directly by the Main South Side Canal total approximately 108,400 acres, about 30,000 acres of which lie under the Ridenbaugh Canal. This distribution system is in condition to supply water to about 70 per cent of the lands under it.

DEER FLAT RESERVOIR.

The Deer Flat reservoir lies in a natural depression situated southwest of Nampa and has a capacity, as now constructed, of 186,000 acre-feet of water, 170,000 of which are available for irrigation and submerges an area of approximately 9,250 acres. It is controlled by two large earthen embankments already constructed and a small embankment and dike yet to be built. The upper Deer Flat embankment, located 4 miles west of Nampa, has a maximum height of 70 feet, a length of crest of 4,000 feet, and contains approximately 932,200 cubic yards of material. This work was done by force account, having been begun in 1906 and finished in 1908. Owing to the appearance of seepage water below the upper Deer Flat embankment, improvements were begun on this structure on June 4, 1909. These improvements consisted of placing a suitably drained gravel blanket, about 200 feet wide and 1,000 feet long, over the area immediately below the embankment, driving the sheet piling along the lower edge of this blanket and installing a drain beneath this blanket immediately above the line of piling for conducting the accumulated seepage water into an open drain. These improvements were completed during August, 1909. It is proposed yet to place additional protection on the water slope against wave action. The lower Deer Flat embankment, situated 5 miles south and 2 miles west of Caldwell, has a maximum height of 40 feet, a length of crest of 7,200 feet, and contains approximately 936,600 cubic yards of material. This embankment was constructed by contract by Hubbard & Carlson. It was begun in 1906 and completed in the spring of 1908. Additional protection on the water slope against wave action is also to be provided for this embankment.

DISTRIBUTION SYSTEM FROM DEER FLAT RESERVOIR.

The canal system from the Deer Flat reservoir may be separated into canals drawing water from the reservoir at the upper Deer Flat embankment and that drawing water therefrom at the lower Deer Flat embankment. The canals from the upper embankment cover approximately 6,600 acres of new land, and the larger of the two canals is designed to supply the Pioneer Irrigation District, containing about 36,000 acres of land, with stored water during the latter part of the irrigation season. The Deer Flat Low Line Canal, taking water from the reservoir at the lower Deer Flat embankment, covers approximately 49,000 acres of land lying south and west of Caldwell and has a total length of 35 miles. Of the area of new lands served by the Deer Flat reservoir about 45 per cent are in condition to receive water at the present time.

TELEPHONE SYSTEM.

Work was begun during March, 1910, on a telephone system for use in the operation of the canal system and the main trunk lines of this telephone system are now completed. Contracts were entered into with two private companies, permitting the use of the poles of their systems for the lines of the Reclamation Service. About 110 miles of metallic circuit have been installed on government pole lines and 32 miles of such circuit on the pole lines of private companies. The system, as now constructed, connects the Boise office with the offices of the various water masters and the whole system is about half completed.

SETTLEMENT.

Practically all of the public lands on the project have been entered and nearly all entries have been conformed to farm unit plats. Chances for additional settlers to obtain land, there-

fore, lie in the subdivision and disposal of private holdings and of homestead entries under the assignment law.

OPERATION AND MAINTENANCE.

The canals of the system ready for carrying water were opened during the irrigation season of 1909, and were operated during that season and during the season of 1910. During 1909 water was delivered to approximately 22,000 acres of land, 18,000 of which were old lands lying under the old New York Canal and 4,000 of which were new lands. In 1910 the total area irrigated was approximately 30,000 acres, including the old New York Canal lands and 12,000 acres of new lands. For the condition of the water supply, which is not yet completed, crop yields have been excellent.

FROST PREVENTION WORK IN THE ROGUE RIVER VALLEY, OREG., DURING THE SPRING OF 1910.

By P. J. O'GARA, Scientific Assistant, Fruit-Disease Investigations, Bureau of Plant Industry.

The work of frost prevention during the past season of spring frosts has been carried on most successfully. The scope of the work has been such as to include practically all the better orchards lying on the valley floor, and the demonstrations can not be considered in any other light than being entirely practical. The experimental work carried on in only a few orchards three seasons ago has been taken up and extended so that at this time it is believed that the matter of frost prevention in the orchards of the Rogue River Valley is a settled problem. During the past season there were just a few orchards in the danger zone carelessly left without protection; luckily these have served as a check on our work. In every case the unprotected orchards lying within the frost zone were badly damaged, and, in some cases, the crop entirely destroyed, while the protected orchards did not show a frost mark or ring on any of the fruit.

During the past season much valuable data have been secured, especially in the matter of orchard fuels and appliances to be used in frost prevention. As in the past two years' work, wood and coal have proven entirely satisfactory, but somewhat cumbersome and difficult to handle. Besides, the wood piles in the orchards have been more or less in the way, making it somewhat difficult to cultivate or work the soil. The same may be said in regard to spraying or carrying on any other orchard work. However, these materials have proven so satisfactory to those who have used them during the past three seasons that they seem willing to accept the difficulties occasioned by their use and will continue using them in the future. To Mr. J. G. Gore should belong the credit of first using wood successfully as a fuel for orchard firing in the Rogue River Valley. During the past three seasons Mr. Gore has saved a pear crop on his 7½-acre Bartlett pear orchard. His first firing was done with old rails which he took from an old fence surrounding the orchard. Later he used cord wood with equal success. The crops harvested during the past three years have been unusually clean, free from all frost marks and very heavy. The trees are about 21 years old at this time, and the average annual crop for the past three seasons has been approximately twelve carloads. His results are in striking contrast with those who failed to protect their orchards which are even less exposed than is Mr. Gore's orchard.

Not only has Mr. Gore saved his pear crops, but his apple crops as well, with the exception of the past season when one freeze found him unprepared and he did not have time to distribute fuel in the apple orchard. As a consequence, a large part of the apple orchard failed to set fruit on account of the blossoms being frozen. In this particular case, the apple orchard, which is directly south of the pear orchard, could not be benefited by any firing in the pear orchard, since the slight air movement was from south to north. Mr. Gore has had the opportunity to see the other fuels tested, namely, coal, crude oil, and distillate; but he is of the opinion that wood is to be pre-